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ABSTRACT

Designed to assist local school districts in New Jersey with resources which might improve elementary science programs, this guide presents science proficiencies for grades K through 6. These proficiencies are illustrated by skills and standards that reflect the broad array of science topics and can be used as benchmarks for the development of quality science programs. The guide is designed to assist teachers, administrators, and science educators in developing, improving, and maintaining their elementary science programs. It contains a scope and sequence chart outlining proficiencies and learning objectives and emphasizes the important concepts in each of the discipline areas of science instruction. Attention is also given to the processes of science. Contents include: (1) perspectives on the need for science instruction (focusing on curriculum formats and skill development); (2) directives on use of the guide; (3) components of science instruction (explaining the elements of the nature of science and providing learning objectives and skills for each of the 12 identified science proficiencies) and (4) a feedback form. (ML)

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Elementary Science Curriculum Guide

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Elementary Science Curriculum Guide

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225 West State Street (CN 500)
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- Revised Edition -

COMMISSIONER'S FOREWORD

If this State and Nation are to maintain and improve their leadership position in the increasingly scientifically-oriented world, we must improve the skills of our youth. This need, identified by state and national study commissions and recognized by our school leaders and science educators, gave rise to this state's Elementary Science Initiative. The purpose of the initiative is to assist local school districts with a number of resources which might improve elementary science programs.

This document, the Elementary Science Curriculum Guide, is one of the products in the initiative and presents proficiencies for grades K-6. These proficiencies are illustrated by skills and standards that reflect the broad array of science topics and can be used as benchmarks for the development of quality science programs for the elementary students of this state.

I invite you to review this publication. It was developed with much input from science educators in our state. The information it contains should be helpful to you in your efforts to develop and improve your elementary science programs.

Saul Cooperman
Commissioner

ACKNOWLEDGMENTS

The New Jersey Department of Education acknowledges with appreciation the generous contributions of time and effort by the Curriculum Committee. The committee members represent a broad range of knowledge and experience in elementary science education. Included on the committee are classroom teachers, science supervisors, and administrators representing urban, suburban, and rural school districts.

In preparing the guide, the Committee referred to many resources dealing with elementary science curricula. Of particular value were the publications, A Recommended Science Competency Curriculum for Grades K to 6 for Pennsylvania Schools, published by the Pennsylvania Department of Education, and Student Performance Standards of Excellence for Florida Schools in Science, published by the Florida Department of Education.

The Department also wishes to thank the teachers, supervisors, and administrators around the state who reviewed the draft of the guide and who offered valuable suggestions that contributed toward the final document.

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REVISED EDITION

Following the distribution of the first edition of this document, the Department of Education carefully tracked the responses of the users. Several thousand science eductors have utilized these guidelines in their curriculum activities and have passed-on invaluable comments. These comments have been reviewed and are reflected in the corrections, revisions and additions found in the 2nd. printing.

ELEMENTARY SCIENCE CURRICULUM GUIDE

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INTRODUCTION

There is a growing awareness that education is facing extraordinary difficulties in meeting the needs of our changing and increasingly scientific society. Students are entering the job market and other post-educational activities without knowing how to make competent decisions about science and scientific issues.

The goal of science education is to develop scientifically literate students who understand how science, technology and society influence one another and who are able to apply this knowledge to their everyday decision making. From selecting new electronic equipment for office and home to voting on nuclear power issues, the student, as he/she becomes part of the general public, will be in a position to make science-related decisions.

It is becoming increasingly evident that the kinds of experiences provided in science at the elementary school level are essential for the future intellectual development of children.[1] In their science courses children need opportunities to handle and experiment with the materials of their physical and natural environment. At this level, children begin to develop the attitudes which will be essential in their everyday decisions and in making them productive members of our society. Through the study of science, children can be exposed to experiences that are the foundation of logical thought and future decision-making. Certain defined basic skills such as observing, sequencing, ordering, measuring, problem solving, and critical thinking are introduced and developed within the elementary school science classroom. These skills are important in other areas of the child's education and are carried over from science instruction into other curriculum areas.

Confirmation of these factors are found in recent reports made in New Jersey. The Governor's Commission on Science and Technology reports that "the curriculum in the elementary schools seems to be the most crucial....many aspects of science are cumulative or hierarchical in nature. Understanding basic concepts and principles is essential for later learning."[2] A report from the Advisory Council on Math/Science Teacher Supply and Demand cites a survey of science teachers at the elementary level which concludes that science is a sequentially learned subject which is generally cumulative or hierarchical in nature and that the understanding of basic concepts and principles at the early grades is essential for later learning.[3] A needs assessment for science completed for New Jersey in 1985 by the New Jersey State Department of Education in cooperation with the New Jersey State Science Supervisors Association corroborates these findings.

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1 "Report of the Science Curriculum Study Group." Tenafly Public Schools, May, 1983, Trenton, New Jersey, pp. 4.

2 "Report of the Governor's Commission on Science and Technology," December, 1983, Trenton, New Jersey, pp. i-iii.

3 "Report of the Advisory Council on Math/Science Teacher Supply and Demand," November 14, 1983, Department of Higher Education, Trenton, New Jersey.

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THE NEED FOR SCIENCE INSTRUCTION

Educators strongly feel that science instruction in the early grades should be a priority concern and that the maintenance of a quality science program is absolutely essential if our youngsters are to be knowledgeable about and participate wisely in our rapidly changing technological society. Since the study of science is so important, we cannot tolerate the indifference, ambivalence, or the "step-child" status which science has often been granted in the elementary school curriculum.[4]

Despite the importance of science, its study has not been emphasized in many schools. The New Jersey Science Teachers' Association reports that "according to a recent Gallup Poll, science ranks fifth, after mathematics, English, social studies, and history, in subject importance to the public."[5] The general emphasis on lower-level basic skills as well as budgetary problems has led to an increasisng lack of science programs in the elementary grades, including decreased scheduled time, disappearance of elementary science specialists, and a curtailing of science in-service training programs for elementary teachers.

At the same time, however, polls and attendance figures report considerable public interest in visiting museums, science fairs, and other out-of-school science activities. A statewide survey of science teaching reports that beginning students have a high regard for science but that it declines in popularity as school years pass. By the end of the third grade only one-half of all students are interested in science and that drops to less than one-fifth by the twelfth grade.[6]

Science is seen by many students as being boring and irrelevant; they hold the view that they are reading about science rather than doing science. There is need to provide students with the opportunity to touch, feel and experience science as a "hands-on" process. These concrete experiences assist students in developing thinking and conceptualization skills, in applying knowledge and in reinforcing their ability to retain content material.

To assist in addressing the problem of students' declining interest and exposure to elementary science, the New Jersey State Department of Education has assembled a distinguished curriculum committee of science educators. They, together with the support and assistance of teachers in the field, and with reference to published materials, have developed this guide:

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[4] "Report of the Science Curriculum Study Group, Tenafly Public Schools, May, 1983, New Jersey, pp. 4.

[5] "Critical Issues in Science Education for New Jersey, A Position Statement," New Jersey Science Teachers Association, Inc., December, 1984.

[6] "A Survey of Science Teaching in the Elementary Schools of New Jersey, 1983-84," New Jersey Science Supervisors Association, May, 1984.

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The guide is designed to assist teachers, administrators and science educators in developing, improving and maintaining their elementary science programs. It contains a scope and sequence chart outlining proficiencies and learning objectives for science instruction in the elementary grades, emphasizing the important concepts underlying each of the disciplines of physics, chemistry, biology, and earth science. Particular emphasis has been placed on the processes of science as illustrated by the inclusion of skills related to critical thinking, decision making, and investigation. These higher order skills have been introduced, developed and reinforced through the K-6 grade levels.

Science Curriculum Formats

Like many elementary school subjects, science is taught in several different instructional formats. Developing and implementing a successful science program at the elementary level requires recognizing these formats and teachers' abilities to deliver the curriculum.

Students may receive their formal science instruction in one or more variations of the following formats.

LOCATION. Students may receive instruction in:

- a self-contained classroom,
- a science center laboratory,
- a specialized science school, and/or
- a field study area.

ORGANIZATIONAL VARIATIONS. Instruction may be organized into:

- an individual lesson
- a project, and/or
- a unit of study.

STAFFING VARIATIONS. Instruction may be provided by:

- an elementary science specialist,
- an itinerant science specialist, and/or
- a self-contained class teacher.

PROGRAM VARIATIONS. Finally, instruction may be guided by curriculum from:

- a nationally recognized program,
- a locally developed program, and/or
- text directed programs.

Although differing instructional formats may have been selected to meet specific instructional and community needs, this Elementary Science Curriculum Guide will support any format that a district may have chosen to use.

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Elementary Science Skills Development

Skills included in the guide were selected based on the following criteria:

1) Is the skill perceived to be important for science students?
2) Is the skill likely to be taught and mastered by the end of grade six?
3) Is the skill important -- but more appropriately taught after grade six?
4) Is the skill more appropriate for testing at primary rather than the secondary grade level?
5) Is the skill a recurring one to be tested periodically, using more complex problems and/or materials?

The identified skills were organized in ascending levels of learning complexity and compiled into twelve proficiencies as illustrated on the chart below. The proficiencies represent general and higher-level competencies, are written in broad general terms, and are intended to communicate with the general public. Also, the learning objectives and skills statements provide teachers and curriculum specialists with more specific in-depth information concerning performance.

The following table summarizes the number of proficiency levels and applicable skills for each grade cluster.

TOTAL NUMBER OF SCIENCE SKILLS BY PROFICIENCY AND GRADE CLUSTER

Proficiency	Skill Identification Numbers	Skills in Grade Cluster K-3	Skills in Grade Cluster 4-6
1	100 to 154	35	48
2	200 to 208	2	9
3	300 to 331	15	23
4	400 to 419	7	14
5	500 to 516	7	11
6	600 to 622	8	16
7	700 to 729	11	20
8	800 to 812	1	12
9	900 to 908	9	9
10	1000 to 1004	2	5
11	1100 to 1107	2	8
12	1200 to 1202	0	3
TOTALS			
12 proficiency levels levels for elementary students		99 skills for grades K-3	178 skills for grades 4-6

Please direct any questions concerning these proficiencies and skills to the New Jersey State Department of Education, Science Projects Coordinator, Division of General Academic Education, 225 West State Street, CN 500, Trenton, New Jersey 08625.

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HOW TO USE THIS K-6 SCIENCE CURRICULUM GUIDE

This guide can assist elementary teachers, administrators, science educators and others in developing a science curricula for elementary schools. It is designed to be flexible enough to meet the needs of all students and to readily accommodate topics of local and regional interest.

The guide divides instruction into two major areas:

I. The Nature of Science: Process and Knowledge - Here, science is discussed as a method of inquiry for obtaining information about our surroundings. This section also provides the teacher with the conceptual framework for designing and presenting science lessons.

II. Proficiencies - Twelve student proficiencies are identified in general terms for inclusion in a science curriculum. They are as follows:

1. Process Skills: The student will **apply** process skills as tools for scientific investigation.

2. Problem-Solving Skills: The student will **apply** problem-solving skills in science.

3. Understanding Life Science Concepts: The student will demonstrate an **understanding** of Life Science concepts and related theories, laws, assumptions and facts.

4 Applying Life Science Concepts: The student will **apply** Life Science concepts and related theories, laws, assumptions and facts.

5. Understanding Physical Science Concepts: The student will demonstrate an **understanding** of Physical Science concepts and related theories, laws, assumptions and facts.

6. Applying Physical Science Concepts: The student will **apply** Physical Science concepts and related theories, laws, assumptions and facts.

7. Understanding Earth/Space Science Concepts: The student will **understand** Earth/Space Science concepts and related theories, laws, assumptions and facts.

8. Applying Earth/Space Science Concepts: The student will **apply** earth/space science concepts and related theories, laws, assumptions and facts.

9. Using Scientific Materials: The student will appropriately use scientific materials, equipment and techniques.

10. Using Scientific Methods: The student will use scientific methods, information and techniques for personal enrichment.

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11. Science, Technology and Society Interactions: The student will describe some of the interactions between science, technology and society.

12. The Nature of Science Characteristics: The student will describe some of the characteristics of the nature of science.

Each proficiency contains a group of learning objectives and skills to provide teachers with more specific information about the expected student performance levels at specified grade ranges: K-3, 4-6, or both. Taken together, the proficiencies offer a comprehensive content base (life, physical and earth/science); move students from lower levels of learning (knowledge, understanding and application) to the higher levels (analysis, synthesis and evaluation); and incorporate objectives in the cognitive, affective and psychomotor domains. Please note that objectives specifically aimed at the affective domain are indicated by "A" on pages 26-29.

This guide has six main objectives. It can be used in a local school district as follows:

1. As an assessment tool within the local school district, the curriculum guide can assist the administration and teaching staffs in assessing their local curriculum. As needed, it can also serve as a guidepost for future expansion and development of the curriculum, allowing the selection of topics based on local or regional needs.

2. As a topical sequence, the guide can be used by the local school district to illustrate a sequence of topics through the elementary grades and maintain continuity with the skill level that the students are developing in other subjects.

3. As an index to local identified programs, the guide can serve as an index to a companion document that will describe various local New Jersey science programs that complement the recommended goals and topics. Interested districts can use the Identified Programs document to arrange first-hand visits or consultations on specific grade levels or units relative to their own programs.

The guide can be used statewide as follows:

1. Identifying a core body of science topics, the guide suggests skills for students statewide while still allowing local districts to maintain topics of local or regional importance in their science programs.

2. As a basis for teacher training, the documents, this guide, the Identified Programs Booklet, and other documents form a basis for future training that can be offered to local school personnel. The training workshops would focus their presentations and efforts on a common theme reflecting the districts' needs in working with their science programs.

3. As a guide to planning skill development efforts within a district, this guide introduces and reinforces skill development necessary for the New Jersey High School Proficiency Test (HSPT). These skills are basic to a sound educational program and can be introduced and supported in a number of academic disciplines.

COMPONENTS OF SCIENCE INSTRUCTION

Comprehensive science programs include not only instruction in specific skills and proficiencies but also instruction and activities to lead students to understand the nature of science and its processes.

I. THE NATURE OF SCIENCE: PROCESS AND KNOWLEDGE

"Discovery comes to the prepared mind"
Louis Pasteur

Students need a structure on which they can hang isolated facts and principles in order to study them and give them meaning. They need organizers so that they can learn to use their knowledge to solve problems. Scientific knowledge, when communicated through and as a "process," can provide students with an important, functional framework for making rational decisions.

It is the responsibility of science educators to emphasize the process of science as a way of learning, and to further emphasize that scientific knowledge is always subject to change based on additional knowledge. We cannot teach students the process of science unless we give them the opportunity to practice it. And, as students repeatedly make observations, measure objects, predict results and define cause-and-effect relationships, they will eventually become adept at not only at using the skills, but at knowing when to use them, as well.

Keeping Louis Pasteur's axiom in mind, when teaching science to children, we should not lose the excitement of investigation while teaching the content of science. There is a balance between the process of science and the knowledge of science, and it is essential that we discover and utilize that balance in our classrooms.

All scientists use problem-solving methods. Observations of material objects or physical phenomena lead to the development of a question. The observations may be many or few, but the presence of patterns or discrepant events in the data produce a problem. This problem is refined and redefined until it is shaped into an hypothesis which can be tested by further observations. The data are analyzed, and they either support the hypothesis or refute it. In the first case the hypothesis is taken as probably true, whereas in the second it is rejected as being not true. This process usually produces more questions; the cycle is repeated; and thus the process continues.

The results of scientific investigation are tentative. They must be open to replication by other scientists. In this way, confidence in the validity of the knowledge may be strengthened, or it may be rejected. Further developments in science often lead to refinement of prior knowledge, and in this sense, scientists never believe that they have found "truth." Perhaps Richard Feynman, the noted Nobel Laureate in Physics and a renowned teacher, said it best when he stated that, "Science is the process for reducing the error in our knowledge of the universe." It is that process we must emphasize in our classrooms today.

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II. SCIENCE PROFICIENCIES

PROFICIENCY 1 - Process Skills

The student will **apply** process skills as tools for scientific investigation:

Learning Objectives and Skills

The student will be able to:		Grade Level K-3	Grade Level 4-6
Communicating			
100	Describe a series of events orally (K-3) and in writing.	X	X
101	Construct a simple bar graph (K-3) properly labeled and scaled.	X	X
102	Construct a simple data table containing two variables. Label columns and rows, and accurately enter data.	X	X
103	Construct a simple line graph which has at least four (4) sets of coordinates, and label all scales and axes.		X
104	Write an accurate and documented paper describing events.		X
Using Time/Space			
105	Identify two-dimensional objects or drawings from within a group which show bilateral and radial symmetry.	X	
106	Identify objects as one-, two-, or three-dimensional.	X	
107	Observe and describe continuous or periodic changes.	X	X
108	Recognize that chemical and physical changes may occur at various rates and patterns.	X	X
109	Sequence the stages of events according to their order of occurrence.	X	
110	Describe an object's position in relation to another object. (Examples moon and Earth)		X
111	Locate positions on a map, given sets of coordinates.		X

PROFICIENCY 1 (continued)

The student will be able to:		Grade Level K-3	Grade Level 4-6
Measuring			
112	Use the International and English units system as the appropriate measure of linear distance, temperature, time, and area units.	X	X
113	Compare information through the use of balances, graphs, diagrams and other visual aids.	X	X
114	Select the appropriate tool for measuring various physical properties of objects.	X	X
115	Use International and English units system as the appropriate measure of volume, mass and area.		X
116	Estimate the length and mass of common objects using International System of units (metric system) and English units.		X
117	Record measurement using appropriate units.	X	X
Observing			
118	Differentiate between actual observations and personal interpretations.		X
119	Identify properties of objects.	X	X
120	Describe a situation, event, or life form using more than one of the senses.	X	X
121	Identify observations which indicate changes in properties of an object.	X	X
122	Distinguish between qualitative and quantitative observations.	X	X
123	Distinguish between observation and inference.	X	X

PROFICIENCY 1 (continued)

The student will be able to:		Grade Level K-3	Grade Level 4-6
Classifying			
124	Sort a set of objects according to similarities and differences.	X	X
125	Develop classification systems.	X	X
126	Use quantitative measurements as criteria for grouping.		X
127	Use a dichotomous key to classify objects/ phenomena.		X
128	Construct two or more classification schemes for the same set of objects.	X	X
Inferring			
129	Recognize that two people may make different inferences from the same observation and neither be wrong.	X	X
130	Identify observations that support an inference.	X	X
131	Describe additional observations needed to test alternative inferences.	X	X
132	Identify inferences that should be accepted, rejected, or modified on the basis of additional observations.	X	X
Predicting			
133	Order a set of predictions in terms of his/her confidence in them.	X	X
134	Predict the consequences of removing or altering one or more components in a system.		X
135	Predict the outcome of an event based upon previously observed conditions.	X	X
136	Construct tests for a prediction.	X	X
137	Interpolate or extrapolate conclusions when given appropriate data tables and graphs.		X
138	Identify and demonstrate a relationship between two variables that can be used to make a prediction.		X

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PROFICIENCY 1 (continued)

The student will be able to:		Grade Level K-3	Grade Level 4-6
Interpreting Data			
139	Distinguish between relevant and irrelevant data.	X	X
140	Communicate supporting data for inference or prediction.	X	X
141	Extract important ideas from reading, listening or watching a presentation.	X	X
142	Read and interpret numerical values from charts, tables or graphs, and apply results when answering questions.		X
143	Interpret cause-and-effect relationships within a scientific problem-solving situation.		X
144	Examine biases and how they can affect/distort data.		X
Identifying Variables			
145	Control the variables in an investigation.		X
146	Construct a test to determine the effects of one or more variables on a responding variable.		X
Formulating Hypotheses			
147	Distinguish between hypotheses and problems.		X
148	Distinguish among opinion, hypotheses, theory and law.		X
149	Distinguish between observations that support a hypothesis and those that do not.		X
150	Revise a hypothesis based upon observations of the test.		X
151	Deduce cause/effect relationships from given data.		X
152	Demonstrate a test of a hypothesis.		X

Experimenting

153	Suggest appropriate experiments to solve simple problems.	X	X
154	Describe the elements of good experimental design (example: problem, hypothesis, purpose, method, findings, data and conclusion).		X

PROFICIENCY 2 - PROBLEM-SOLVING SKILLS

The student will **apply** problem-solving skills in science.

Learning objectives and skills

The student will be able to:		Grade Level K-3	Grade Level 4-6
Experimenting			
200	Ask appropriate questions when a problem is stated.	X	X
201	Recognize solutions to simple problems and appropriately modify an effective solution.	X	X
202	Recognize alternative factors to be considered when examining possible solutions to a problem.		X
203	Propose alternative strategies to the solution of a problem.		X
204	Establish criteria by which to judge a solution.		X
205	Collect, group, analyze, regroup and synthesize information relative to a problem.		X
206	Identify alternative courses of action which may result in a solution to the problem.		X
207	Demonstrate an open-minded and imaginative approach to problem solving.		X
208	Use a model or drawing to visualize the solution to a problem.		X

PROFICIENCY 3 - UNDERSTANDING LIFE SCIENCE CONCEPTS

The student will demonstrate an **understanding** of life science concepts and related theories, laws, assumptions and facts.

Learning objectives and skills

The student will be able to:		Grade Level K-3	Grade Level 4-6
General			
300	Identify the characteristics of living and non-living things.	X	
301	Identify the similarities and differences between plants and animals.	X	
302	List the requirements necessary for life, as we know it.		X
303	Identify how fossils indicate how plants and animals have changed over periods of time.	X	X
Plants			
304	Compare the structure of plants that live in water to those that live on land.	X	
305	State the environmental factors plants need in order to grow and reproduce.	X	
306	Identify the process by which plants produce food.		X
307	Identify physical changes in a germinating plant seed.	X	
308	Identify the place of plant transpiration in the water cycle.		X
309	Identify a producer, consumer and decomposer.	X	X
310	Identify how coal and oil were formed from plants.		X
311	Identify differences and similarities between fungi and green plants.		X
312	Identify the various tropisms in plants.		X
313	Identify the major structures and functions of seed plants.	X	X

PROFICIENCY 3 (continued)

The student will be able to:		Grade Level K-3	Grade Level 4-6
Animals			
314	Identify similarities and differences in animals on the basis of body parts, organs, systems.		X
315	Identify physical characteristics of invertebrates and vertebrates that aid them in adapting to their environments.	X	X
316	Identify unique characteristics of fish, amphibians, reptiles, birds and mammals.	X	
317	Identify the impact invertebrates and vertebrates have upon people.	X	X
318	Define cells, tissues, organs and systems.		X
319	Identify and differentiate among the various body tissues (skin, blood, muscle, bone and nerve).		X
320	Identify those cells in the human body that are not capable of regeneration.		X
321	Identify the general functions of the major organs and systems of the human body.		X
Protists			
322	Define micro-organisms.		X
323	Identify the basic types of micro-organisms and their importance in a food chain.		X
Ecology			
324	Define and give examples of habitats.	X	X
325	Identify the relationship between population and a community.	X	
326	List ways that arthropods, particularly insects, affect people both positively and negatively.		X
327	Identify some economic benefits of invertebrates; of verterbrates.		X

PROFICIENCY 3 (continued)

The student will be able to:		Grade Level K-3	Grade Level 4-6
Ecology (continued)			
328	Describe the physical and behavioral adaptations that allow animals to live successfully in their environment.	X	X
329	Describe the changes necessary for survival of a species.		X
330	Identify evidences of interdependence between organisms.	X	X
331	State the importance of soil, water, air, sunlight, temperature, producers, consumers and decomposers in an ecosystem.		X

PROFICIENCY 4 - APPLYING LIFE SCIENCE CONCEPTS

The student will **apply** life science concepts and related theories, laws, assumptions and facts.

Learning objectives and skills

The student will be able to:		Grade Level K-3	Grade Level 4-6
General			
400	Summarize the similarities and differences between plants and animals.		X
401	Trace the life cycles of various plants and animals.	X	X
Plants			
402	Describe the process through which plants produce food.		X
403	Generalize about the many different ways seeds can scatter.	X	
404	Describe adaptations of plants to special conditions.	X	
405	Describe the role of plant transpiration in the water cycle.		X
406	Classify leaves, seeds and flowers as monocots or dicots.		X
407	Differentiate between asexual and sexual reproduction in plants (including vegetative propagation).		X
Animals			
408	Construct your own classification system to identify animals.	X	
409	Classify organisms in a standard classification system as to whether they are insects, arachnids, mollusks, fish, birds, amphibians, reptiles or mammals.	X	X
410	Describe how instinctive behavior helps animals.	X	
411	Illustrate how behavior of marine or fresh water organisms as different environmental variables are experienced.	X	

PROFICIENCY 4 (continued)

The student will be able to:		Grade Level K-3	Grade Level 4-6
Ecology			
412	Construct a food chain to indicate producers and consumers.		X
413	Illustrate how a pyramid of energy works.		X
414	Define a member of an ecosystem such as producer, consumer or decomposer.		X
415	Diagram an energy food web.		X
416	Explain the importance in an ecosystem of each of the following: soil, water, air, sunlight, temperature, producer, consumer and decomposer.		X
417	Interpret the effects on populating growth resulting from the increase of these five variables: food, space, disease, predators and environmental change.		X
418	Evaluate the effects of human and industrial influences on ecosystems.		X
419	Identify the developing environmental problems facing New Jersey such as solid waste, sewage, water resource management, air pollution, conservation and energy.		X

PROFICIENCY 5 - UNDERSTANDING PHYSICAL SCIENCE CONCEPTS

The student will demonstrate an **understanding** of physical science concepts and related theories, laws, assumptions and facts.

Learning objectives and skills

The student will be able to:		Grade Level K-3	Grade Level 4-6
Matter			
500	Classify common changes in matter as physical or chemical.		X
501	Distinguish among elements, compounds and mixtures.		X
502	State the simple properties of matter.	X	
503	Identify some factors which can affect a change in the state of matter.	X	
504	Identify chemical properties of matter.		X
505	Identify the differences between mixtures and solutions.		X
506	Identify the differences between mass and weight.		X
Energy/Forces			
507	State the action observed when two magnets influence each other.	X	
508	Identify simple machines and their use.	X	X
509	Identify the general effects on molecules when heat is applied.		X
510	State that every object exerts an attraction force on every other object.		X
511	Identify the properties of heat, light, electricity, mechanics, magnetism and sound as energy forms.	X	X
512	State those characteristics of an electromagnet which determine its strength.		X
513	Identify the production of light as electrical or chemical energy conversion.		X
514	Identify the results of the interaction of magnetic forces on objects.	X	X

PROFICIENCY 5 (continued)

The student will be able to:		Grade Level K-3	Grade Level 4-6
Matter/Energy			
515	Identify clues that tell whether an object is in motion.		X
516	Infer from visual clues the direction an object is moving.		X

PROFICIENCY 6 - APPLYING PHYSICAL SCIENCE CONCEPTS

The student will **apply** physical science concepts and related theories, laws, assumptions and facts.

Learning objectives and skills

The student will be able to:		Grade Level K-3	Grade Level 4-6
Matter			
600	Classify a substance as solid, liquid or gas when given its properties.	X	X
601	Demonstrate that chemical reactions produce new substances.		X
602	Explain the difference between an atom and a molecule.		X
Energy/Forces			
603	Describe the shape of the magnetic field around a bar magnet.	X	X
604	Predict the pitch of a sound on the basis of the instrument size.	X	X
605	Use simple machines.	X	X
606	Differentiate between physical and chemical changes.		X
607	Describe methods used to reduce noise.		X
608	Construct an electromagnet.		X
609	Explain why friction causes objects to become warmer.	X	X
610	Describe and demonstrate how vibrations produce sounds.	X	X
611	Differentiate between parallel and series circuits.		X
612	Construct parallel and series circuits.		X

PROFICIENCY 6 (continued)

The student will be able to:		Grade Level K-3	Grade Level 4-6
Energy/Forces (continued)			
613	Construct a simple generator, changing one form of energy to another.		X
614	Explain the differences among kinetic, potential and radiant energy.		X
615	Explain the difference between temperature and heat.		X
616	Explain the relationship between molecular motion and heat.		X
617	Compare and contrast the effects of heat and light on substances of different colors and materials.		X
618	Predict the effect on a lamp when the circuits are opened or closed at any point with parallel and series circuits.		X
619	Identify how materials vary in their ability to conduct sound.	X	X
620	Demonstrate how to change the pitch of a simple musical instrument.	X	X
Matter/Energy			
621	Interpret the direction an object is moving from visual clues.	X	
622	Explain how everyday tools or devices change the strength or direction of a force.		X

PROFICIENCY 7 - UNDERSTANDING EARTH/SPACE SCIENCE CONCEPTS

The student will demonstrate an **understanding** of earth/space science concepts and related theories, laws, assumptions and facts.

Learning objectives and skills

The student will be able to:		Grade Level K-3	Grade Level 4-6
Space			
700	Explain day and night as a result of the earth's rotation.	X	
701	Define the meaning of satellite.	X	
702	Indicate why moonlight is in reality reflected sunlight.	X	
703	Identify the relative features of bodies within our solar system (e.g., size, brightness and temperature).	X	X
704	Explain seasons as a result of the earth's revolution and tilt.		X
705	Identify some benefits derived from space technology.		X
706	Relate the motions of the moon to its phases.		X
707	Identify the relative positions of heavenly bodies in the formation of a solar and lunar eclipse.		X
Earth			
708	Recognize that the forces of weathering and erosion (wind, ice, and water) are constantly changing the earth's surface.	X	X
709	Identify various earth materials (rocks, soil, sand and clay).	X	X
710	List major types of energy sources.	X	X
711	Identify the effects of weathering, erosion, volcanism, earthquakes and glaciation upon the earth's surface.	X	X

PROFICIENCY 7 (continued)

The student will be able to:		Grade Level K-3	Grade Level 4-6
Earth (continued)			
712	Cite examples of non-renewable natural resources and describe their nature.		X
713	Identify examples of rocks and minerals		X
714	Identify how igneous, metamorphic and sedimentary rocks are formed.		X
Water			
715	Identify living and non-living sea products and describe their benefit to humanity.	X	X
716	List reasons for protecting the water environment.	X	
717	Identify water movement in the ocean including waves, tides and currents.	X	X
718	Identify the necessary steps for cleaning wastes from water.		X
719	Identify ways in which people benefit from the ocean.	X	X
720	List factors that affect the movement of ocean water, including wind, temperature and gravitation.		X
721	Trace the water cycle and identify factors which affect it.	X	X
Air			
722	Identify climates of the world.	X	X
723	Identify the components of weather, including temperature, clouds, wind and precipitation.	X	X
724	Identify and associate cloud types with patterns.		X
725	Identify frontal lines on a map and assess weather conditions pertaining to it.		X

PROFICIENCY 7 (continued)

The student will be able to:

		Grade Level K-3	Grade Level 4-6
Air (continued)			
726	Describe the processes of evaporation and condensation in relation to cloud formation and humidity.		X
727	Define weather.		X
728	Identify weather-forecasting instruments including thermometer, barometer, psychrometer and anemometer, and state their functions.		X
729	Describe the effect that oceans have upon climate.		X

PROFICIENCY 8 - APPLYING EARTH/SPACE SCIENCE CONCEPTS

The student will **apply** earth/space science concepts and related theories, laws, assumptions and facts.

Learning objectives and skills

The student will be able to:		Grade Level K-3	Grade Level 4-6
Space			
800	Explain how the sun may be used to determine time.	X	X
801	Explain how our units of time are based on astronomical motions.		X
802	Describe our solar system.		X
Earth			
803	Use specific examples to illustrate the results of forces that change the surface of the earth.		X
804	Describe and classify mineral samples according to hardness, luster, streak and color.		X
805	Describe the internal structure of the earth.		X
Water			
806	Describe how the ocean is important for mineral and energy resources.		X
807	Describe how water influences the formation and erosion of soil and beaches.	X	X
Air			
808	Describe common factors shared by areas with similar climates.		X
809	Predict weather based upon information regarding temperature, cloud types, wind and other data.		X
810	Construct and use student-made weather forecasting instruments to record the weather.	X	X
811	Explain why some types of violent storms are more common in one region than in another.		X
812	Describe how technology is used to study weather.	X	X

PROFICIENCY 9 - USING SCIENTIFIC MATERIALS

The student will appropriately use scientific materials, equipment and techniques.

Learning objectives and skills

The student will be able to:		Grade Level K-3	Grade Level 4-6
900	Manipulate scientific materials and equipment appropriate to his/her grade level.	X	X
901	Describe and illustrate care for scientific equipment. (A)	X	X
902	Describe and illustrate how to handle and care for living organisms. (A)	X	X
903	Describe how to care for scientific materials appropriate to his/her grade level. (A)	X	X
904	Construct equipment appropriate for investigations.	X	X
905	Assemble equipment appropriate for investigations.		X
906	Identify and use safe laboratory procedures. (A)	X	X
907	Choose science equipment appropriate for tasks.	X	X
908	Match the names and functions of science equipment.	X	X

(A) Indicates objectives specifically aimed at the affective domain.

PROFICIENCY 10 - USING SCIENTIFIC METHODS

The student will use scientific methods, information and techniques for personal enrichment.

Learning objectives and skills

The student will be able to:		Grade Level K-3	Grade Level 4-6
1000	Describe and utilize scientific knowledge and skills in everyday situations. (A)	X	X
1001	Participate in extracurricular science-related activities. (A)		X
1002	Select and illustrate cause-and-effect relationships to explain contemporary problems. (A)		X
1003	Illustrate the use of scientific processes in personal decision making.	X	X
1004	Read advertisements and other commercial messages objectively and describe words that support inferences, half-truths and emotional appeal.		X

PROFICIENCY 11 - SCIENCE, TECHNOLOGY AND SOCIETY INTERACTIONS

The student will **describe** some of the interactions between science, technology and society.

Learning objectives and skills

The student will be able to:

		Grade Level K-3	Grade Level 4-6
1100	Describe and recognize the direct and indirect roles of individuals on environmental quality.	X	X
1101	Identify individuals and groups whose efforts, ideas or inventions have significantly affected the lives of other human beings, and describe their influences. (A)	X	X
1102	Discuss attitudes which contribute toward living in harmony with the environment. (A)	X	X
1103	Cite examples of occupations that are primarily concerned with the study or control of specific environments.		X
1104	Identify governmental and nongovernmental groups primarily concerned with environmental matters.		X
1105	Describe the various society, cultural and industrial impacts on the environment.	X	X
1106	Explain and evaluate some effects of technology (e.g., inventions and methods of production) on the relationship between human beings and physical environment.	X	X
1107	Describe the industrial, domestic, transportation and agricultural changes in natural environments and identify possible social reactions to these changes in the environment. (A)		X

PROFICIENCY 12 - THE NATURE OF SCIENCE CHARACTERISTICS

The student will **describe** some of the characteristics of the nature of science.

Learning objectives and skills

The student will be able to:		Grade Level K-3	Grade Level 4-6
1200	Distinguish between science and technology.		X
1201	Describe the scientific community and their ability to be sensitive to normal human concerns. (A)		X
1202	Recognize the tentativeness of scientific "truths."		X

ELEMENTARY SCIENCE CURRICULUM GUIDE

Feedback Form

The Department of Education would appreciate your feedback after you have used this guide for several months. Your response will be most welcome. Please make a photocopy of this page and return it to the address below.

What is your Position/Grade Level

_____ Principal _____ Teacher _____ Other (specify)

_____ Gr. K-8 _____ Gr. 9-12 _____ Other (specify)

1. From whom did you receive this guide?

   _____ Principal _____ Teacher _____ Curr. Coordinator _____ Other

2. How much helpful information is provided by this guide?

   _____ Much _____ Some _____ Little _____ None

   What are the two most useful items you have found?

   a. _____
   b. _____

3. Is the manual easy to read and understand?

   _____ Yes _____ No

4. What are the possible <u>student</u> outcomes that you can forsee from the use of this guide?

   _____

   _____

6. Will you use it in the future?

   _____ Yes _____ No

7. What other information should be added to this guide?

   _____

8. Other comments. Please write comments on the back of this page.

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New Jersey State Department of Education
CN 500
225 West State Street
Trenton, New Jersey 08625

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